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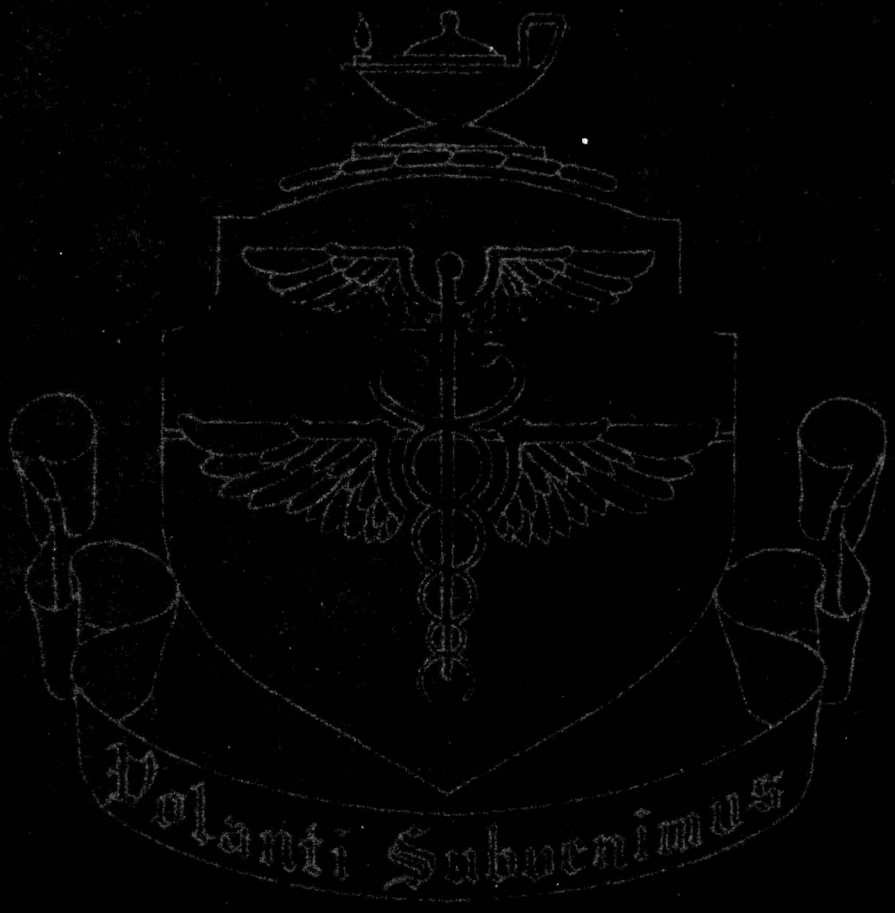

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"ABSOLUTE" VERSUS "RELATIONAL" DISCRIMINATION OF INTERMEDIATE SIZE IN THE RHESUS MONKEY

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"ABSOLUTE" VERSUS "RELATIONAL" DISCRIMINATION OF INTERMEDIATE SIZE IN THE RHESUS MONKEY

Nine rhesus monkeys were successively trained and tested on two intermediate-size transposition problems. In problem I responses based on "relative" stimulus properties were opposed to chance behavior determined by "absolute" stimulus properties, and the subjects indicated significant learning of stimulus relationships. Problem II was designed in such a way that different nonchance behaviors should result from response to "absolute" and "relational" stimulus properties, and the subjects consistently reverted to choices based on "absolute" stimulus properties. It is concluded that rhesus monkeys learn both "absolute" and "relational" cues during training in a single stimulus-situation and that there is a strong tendency to respond to "absolute" stimulus values whenever feasible.

Transposition of responses to the intermediate-size stimulus has been considered a critical test by proponents of both S-R and perceptual theories of discrimination learning. Spence (3) failed to find evidence of relational learning in chimpanzees when "absolute" and "relational" tendencies were directly opposed in the test for transposition. Gonzales et al. (2) modified the transposition testing procedure so that no single choice was determined by "absolute" stimulus values, and significant "relational" learning was evidenced by the chimpanzees in their experiment. Recently, Gentry et al. (1) confirmed the finding of relational learning of the intermediate-size problem in an experiment involving rhesus monkeys.

The present investigation compares the performance of a single group of rhesus monkeys on two intermediate-size transposition problems in an effort to rationalize the apparently conflicting evidence. Each S in the present experiment was first trained and tested on an intermediate-size transposition problem as designed by Gonzales et al. (2). Subsequently, each S was retrained and tested on an intermediate-size transposition problem as designed by Spence (3). An increase in understanding of the discrimination process is sought by comparing results obtained from the two transposition testing procedures.

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METHOD

Subjects

Nine adult male rhesus monkeys approximately 4 years old were the subjects. Each had previous experience on a variety of discrimination tasks during the two years before the start of this experiment. The monkeys were caged separately in air-conditioned quarters and fed at the conclusion of each test day.

Apparatus

A string-pulling apparatus, described in detail elsewhere (1, 2), was employed throughout the experiment. The stimuli were nine cubical wooden boxes, each of which was open at the top and painted black inside and out. The boxes were designated in order of size with the numbers 1 to 9. Each face of the smallest box was 9 sq. in. in area, and the surface area of each successive box in the series increased by a factor of 1.15. On each trial, three of the boxes were presented, 8 in. apart at a distance of 30 in. from the S.

Procedure

Problem I. In the first problem each monkey was first trained, to a criterion of 16 correct out of 18 trials, to choose the intermediate size when presented with stimuli 3, 5, and 7, with the intermediate-size stimulus being the positive one. The correction method was employed on all training trials. In the test for transposi-

tion, two new sets of stimuli were employed — 2, 4, 6, and 4, 6, 8. During this phase of the experiment, the Ss continued to receive 18 trials a day—12 training trials with 6 test trials interspersed. The training trials continued to involve stimuli 3, 5, and 7, with the intermediate size rewarded. Three test trials each day involved stimuli 2, 4, 6, and three involved 4, 6, 8; on these trials any choice was rewarded. In four days of testing, each set was presented 12 times, twice in each of the six possible spatial arrangements.

Problem II. In the second problem each monkey was retrained, to a criterion of 16 correct out of 18, on stimulus set 3, 5, 7 (a criterion which was quickly reached). The correction method was employed throughout. In this problem the test for transposition was conducted exactly as in the first problem, 6 tests out of 18 trials a day for four days, except that the test sets now included stimuli 1, 3, 5, and 5, 7, 9. Thus, each test set included one previously rewarded and one previously nonrewarded stimulus object, with the latter intermediate in size within the test set. On test trials each of the six possible spatial arrangements were presented equally often and any choice was rewarded, as in the first problem.

RESULTS

Problem I

When the test for transposition paired a "relational" choice with chance preference based on "absolute" stimulus values, the monkeys demonstrated significant choice of the intermediate-size stimuli of the test sets. Table I presents the results of the first problem for each of the nine monkeys. A simple S-R association theory predicts equal preference for stimuli 4 and 6 in each test set; thus, response on the basis of "absolute" value should result in choice of the intermediate-size stimulus about 50 percent of the time. A t-test (4, p. 135) was employed and choice of the intermediate-size stimulus on all test trials (sets 2, 4, 6 and 4, 6, 8) in problem I was found to exceed chance at the .05 level of significance. At the same time, the Ss indicated a significant preference for "absolute" value 6 on test trials ($P<.01$).

Problem II

Table II presents the results of the second transposition problem for each of the nine monkeys. When the test for transposition paired an intermediate-size stimulus with the "absolute" stimulus value which was rewarded during training, the monkeys consistently chose the test stimulus of the "absolute" size which was positive on training trials and failed to choose the intermediate-size test stimulus. Whereas, in problem I, the Ss had indicated a significant "relational" tendency, these same Ss reverted to a highly consistent choice of the "absolute" stimulus value in problem II.

A nonparametric sign-test for paired observations was employed (4, p. 430) and the number of choices of the intermediate-size stimulus was found to differ at the .01 level of significance for the two tests of transposition — i.e., sets 2, 4, 6 and 4, 6, 8.

DISCUSSION

It is apparent that rhesus monkeys learn both "absolute" and "relational" stimulus properties during discrimination training; thus neither an "absolute" nor a "relational" theory of discrimination learning accounts for all of the data. As Spence (3) has noted, theories of relational learning fail to consider factors which limit the range of transposition; consequently, "relational" type theories should predict choice of the intermediate-size stimulus in each of the present problems. Although significant evidence of relational learning was observed in problem I, a highly significant failure to choose the intermediate size resulted in problem II. On the other hand, whereas the "absolute" type theory of discrimination espoused by Spence (3) predicts correctly choice of the nonintermediate test stimulus of problem II, it cannot predict above chance choice of the intermediate-size stimulus in problem I.

TABLE I

Distribution of responses on 24 test trials of problem 1

Animal		Choices on test trials				Number of choices of intermediate size
		No. 2	No. 4	No. 6	No. 8	
1	Set 2, 4, 6	0	9	3		
	Set 4, 6, 8		2	10	0	19
2	Set 2, 4, 6	0	3	9		
	Set 4, 6, 8		1	11	0	14
3	Set 2, 4, 6	0	0	12		
	Set 4, 6, 8		1	11	0	11
4	Set 2, 4, 6	2	3	7		
	Set 4, 6, 8		2	10	0	13
5	Set 2, 4, 6	0	3	9		
	Set 4, 6, 8		0	12	0	15
6	Set 2, 4, 6	1	3	8		
	Set 4, 6, 8		2	10	0	13
7	Set 2, 4, 6	0	5	7		
	Set 4, 6, 8		5	7	0	12
8	Set 2, 4, 6	0	2	10		
	Set 4, 6, 8		1	10	1	12
9	Set 2, 4, 6	0	6	6		
	Set 4, 6, 8		2	10	0	16

In the present experiment, a slight difference in the degree of stimulus transposition on test trials resulted in extreme differences in number of choices of the intermediate-size stimulus. When translation along the size continuum was calculated to minimize preferences between test stimuli based on "absolute" stimulus properties, significant evidence of "relational" learning was found. When stimulus transposition resulted in a definite preference based upon "absolute" stimulus values, no evidence of relational learning was observed. The results of the present experiment suggest that "lower" primates learn both "relationships" and "absolute" stimulus values; however, the tendency to respond on the basis of "absolute" stimulus values is the stronger tendency and "relational" properties are employed as a basis for response selection only when differential "absolute" values are lacking.

The degree of relational learning manifested by Ss in this experiment, although statistically significant, was not as great as that evidenced

TABLE II

Distribution of responses on 24 test trials of problem II

Animal		Choices on test trials					Number of choices of intermediate size
		No. 1	No. 3	No. 5	No. 7	No. 9	
1	Set 1, 3, 5	0	1	11			
	Set 5, 7, 9			12	0	0	1
2	Set 1, 3, 5	0	0	12			
	Set 5, 7, 9			12	0	0	0
3	Set 1, 3, 5	0	0	12			
	Set 5, 7, 9			10	1	1	1
4	Set 1, 3, 5	0	0	12			
	Set 5, 7, 9			12	0	0	0
5	Set 1, 3, 5	0	0	12			
	Set 5, 7, 9			12	0	0	0
6	Set 1, 3, 5	0	0	12			
	Set 5, 7, 9			12	0	0	0
7	Set 1, 3, 5	0	1	11			
	Set 5, 7, 9			12	0	0	1
8	Set 1, 3, 5	0	0	12			
	Set 5, 7, 9			12	0	0	0
9	Set 1, 3, 5	0	1	11			
	Set 5, 7, 9			12	0	0	1

by chimpanzees (2) or by another group of rhesus monkeys in a separate study (1). A possible explanation for differences between the two groups of monkeys tested at this laboratory involves differences in age and experience of the Ss, the monkeys of the present experiment being younger and less sophisticated than those of the other experiment.

In view of the relatively weak "relational" tendencies exhibited in the present experiment, it is interesting to note that transposition testing in problem I revealed significant "absolute" response tendencies as well. Although an effort was made to equate the size differences between test stimuli 4 and 6 and the positive training stimulus 5, the monkeys developed a significant preference for stimulus object 6. Since a preference for one specific stimulus object, disregarding relative properties, cannot be predicted from a "relational" type theory, it must be concluded that the monkeys demonstrated associations for "absolute" stimulus properties in the first problem as well as the second.

The test for transposition is employed as a *test* of what the S has learned during discrimination training. The present experiment indicates that monkeys actually learn *both* "absolute" and "relational" stimulus properties and that they attend to both within the *same* stimulus situation. Transposition testing on problem I indicated significant attention to "relational" stimulus properties; moreover, the testing procedure reinforced the relational choice. The *same* Ss, after more training on the *same* problem for which relational learning had been demonstrated, evidenced strong associations for "absolute" stimulus properties when the testing situation was changed to allow these associations to become manifest.

SUMMARY

Nine rhesus monkeys were successively trained and tested on two intermediate-size transposition problems. In problem I responses based on "relative" stimulus properties were opposed to *chance* behavior determined by "absolute" stimulus properties, and the Ss indicated significant learning of stimulus relationships. Problem II was designed in such a way that different nonchance behaviors should result from response to "absolute" and "relational" stimulus properties, and the Ss consistently reverted to choices based on "absolute" stimulus properties. It is concluded that rhesus monkeys learn both "absolute" and "relational" cues during training in a single stimulus-situation and that there is a strong tendency to respond to "absolute" stimulus values whenever feasible.

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